

Claims

What is claimed is:

- 5 1. A node-and-strut structure comprising:
- a set of at least six vertebrae each including one left-hand strut having
 a proximal portion and a distal portion, one right-hand strut having a
 proximal portion and a distal portion, and one primary node rigidly engaging
 the left-hand strut's proximal portion and the right-hand strut's proximal
10 portion, a primary axis passing through each of the primary nodes, the
 primary nodes each including at least 1% metal by weight, the left-hand struts
 all being nominally mutually parallel, the right-hand struts all being
 nominally mutually parallel also;
- several left-hand nodes each bearing against a respective one of said
15 left-hand struts' distal portions such that a left-hand axis lying in a baseplane
 with the primary axis passes through each of the left-hand nodes, the left-
 hand axis forming with each of the left-hand struts an acute angle about equal
 to $j \times 20.9^\circ + k \times 31.7^\circ + m \times 36^\circ + n \times 37.4^\circ$, where j, k, m, and n are each an
 integer ≥ 0 ; and
- 20 several right-hand nodes each bearing against a respective one of said
 right-hand struts' distal portions such that a right-hand axis parallel to the
 baseplane passes through each of the right-hand nodes, the right-hand axis
 forming with each of the right-hand struts an acute angle about equal to
 $p \times 20.9^\circ + q \times 31.7^\circ + r \times 36^\circ + s \times 37.4^\circ$, where p, q, r, and s are each an integer \geq
25 0.
2. The node-and-strut structure of claim 1 in which said nodes each primarily
 comprise an iron-containing alloy.

3. The node-and-strut structure of claim 1 in which said nodes each include at least 1% metal by weight.
- 5 4. The node-and-strut structure of claim 1 in which said struts each include at least 1% carbon fiber by weight.
5. The node-and-strut structure of claim 1 in which all of said acute angles that are formed with the left-hand axis are within 0.4° of $j \times 20.9^\circ + k \times 31.7^\circ + m \times 36^\circ + n \times 37.4^\circ$.
10
6. The node-and-strut structure of claim 1 in which said left-hand and right-hand nodes each have a metallic surface bearing against a respective one of said distal portions.
15
7. The node-and-strut structure of claim 1 in which the left-hand and right-hand struts of each of the vertebrae form a primary angle therebetween that is nominally equal to an acute angle of $b \times 20.9^\circ + d \times 31.7^\circ + e \times 35.3^\circ + f \times 36^\circ$, where b, d, e, and f are each an integer ≥ 0 .
20
8. The node-and-strut structure of claim 1 in which the left-hand and right-hand struts of each of the vertebrae form a primary angle therebetween that is nominally complementary to an acute angle of $b \times 20.9^\circ + d \times 31.7^\circ + e \times 35.3^\circ + f \times 36^\circ$, where b, d, e, and f are each an integer ≥ 0 .
25
9. The node-and-strut structure of claim 1 in which the left-hand and right-hand struts of each of the vertebrae form a primary angle therebetween that is nominally complementary to an acute angle of $b \times 20.9^\circ + d \times 31.7^\circ + e \times 35.3^\circ + f \times 36^\circ$, where b is a positive integer and d, e, and f are each an integer ≥ 0 .
30

10. The node-and-strut structure of claim 1 in which the left-hand and right-hand struts of each of the vertebrae form a primary angle therebetween that is nominally complementary to an acute angle of $b \times 20.9^\circ + d \times 31.7^\circ + e \times 35.3^\circ + f \times 36^\circ$, where d is a positive integer and b, e, and f are each an integer ≥ 0 .
5
11. The node-and-strut structure of claim 1 in which the left-hand and right-hand struts of each of the vertebrae form a primary angle therebetween that is nominally complementary to an acute angle of $b \times 20.9^\circ + c \times 30^\circ + d \times 31.7^\circ + e \times 35.3^\circ + f \times 36^\circ + g \times 37.4^\circ$, where b, c, d, e, f, and g are each an integer ≥ 0 .
10
12. The node-and-strut structure of claim 1 in which the set of vertebrae are nominally regularly spaced.
- 15 13. The node-and-strut structure of claim 1 in which $j > 0$.
14. The node-and-strut structure of claim 1 in which $k > 0$.
15. The node-and-strut structure of claim 1 in which $j = p = 0$.
20
16. The node-and-strut structure of claim 1 in which $k = q = 0$.
17. The node-and-strut structure of claim 1 in which $m = r = 0$.
- 25 18. The node-and-strut structure of claim 1, further comprising several additional strut ends each bearing against a corresponding one of the left-hand nodes.

19. The node-and-strut structure of claim 18 in which the number of said additional strut ends is exactly T, where T is at least 4.

5 20. The node-and-strut structure of claim 1 in which the set of vertebrae includes at least eight vertebrae.

21. The node-and-strut structure of claim 1, further including several inter-primary struts each coupled to a corresponding pair of the primary nodes.

10

22. The node-and-strut structure of claim 1, in which said nodes and several additional nodes are all positioned exteriorly so as to form an oblong shape substantially resembling a tube having an elliptical cross section, further comprising several other, interiorly-positioned nodes.

15

23. A method of making a node-and-strut structure comprising steps of:
- (a) assembling a set of at least six vertebrae each including one left-hand strut having a proximal portion and a distal portion, one right-hand strut having a proximal portion and a distal portion, and one primary node rigidly engaging the left-hand strut's proximal portion and the right-hand strut's proximal portion, a primary axis passing through each of the primary nodes, the primary nodes each including at least 1% metal by weight, the left-hand struts all being nominally mutually parallel, the right-hand struts all being nominally mutually parallel also;
- (b) bringing several left-hand nodes each to bear against a respective one of said left-hand struts' distal portions such that a left-hand axis lying in a baseplane with the primary axis passes through each of the left-hand nodes, the left-hand axis forming with each of the left-hand struts an acute angle about equal to $j \times 20.9^\circ + k \times 31.7^\circ + m \times 36^\circ + n \times 37.4^\circ$, where j, k, m, and n are each an integer ≥ 0 ; and
- (c) bringing several right-hand nodes each to bear against a respective one of said right-hand struts' distal portions such that a right-hand axis parallel to the baseplane passes through each of the right-hand nodes, the right-hand axis forming with each of the right-hand struts an acute angle about equal to $p \times 20.9^\circ + q \times 31.7^\circ + r \times 36^\circ + s \times 37.4^\circ$, where p, q, r, and s are each an integer ≥ 0 .
24. The method of claim 23, further including a triangulation step (d) of adding to said node-and-strut structure several additional nodes and several additional struts so that all of the nodes each bear against at least 3 of the struts that are not nominally mutually coplanar.
25. The method of claim 24 in which said struts each have an actual length that is nominally included in a predefined length set consisting of 6 lengths.